REMARKS

The Office Action of July 20, 2009 has been carefully studied. Favorable reconsideration and allowance of the claims are respectfully requested.

I. Claim Status and Amendments

Claims 1, 2, and 4-20 presently appear this application. Claims 1, 2, 4-11, and 17-19 have been examined on the merits and stand rejected. Claims 12-16 and 20 have been withdrawn.

By way of the present amendment, claims 1, 6-11, 17, and 18 have been amended. Support for amended claim 1 can be found in the disclosure, for example, at page 7, lines 7-13, at page 9, lines 18-27, at page 14, lines 4-22, and at page 15, lines 1-8.

Claims 6-11 have been amended, in a non-narrowing manner, to be consistent with the revised language of claim 1 and to conform to US practice. In addition, claim 8 has been amended to correct an obvious typographical error. Claims 17 and 18 have been amended, in a non-narrowing manner, to better clarify the recited method steps. Support can be found in the claims as filed. Such amendments are non-substantive and not intended to narrow the scope of protection. In keeping with US law, the use of "a" or "an" in patent parlance carries the meaning of "one or more". No new matter has been added.

Applicants request favorable reconsideration, entry of the present amendment, and formal allowance of the claims.

II. Claim Objections

On page 2, the examiner objects to claim 8 for containing an underscore between the phrase "and_have" that should have been deleted. The present amendment corrects this obvious typographical error. Withdrawal of the objection is requested.

III. Obviousness Rejection Under 35 U.S.C. §103

Claims 1, 2, and 6-11 have been rejected under 35 U.S.C. §103(a) as being obvious over Bagrodia et al. (WO 01/40369) in view of Frank (US 5,217,762) for the reasons on pages 4-6 of the Office Action.

Claims 4 and 5 have been rejected under 35 U.S.C. §103(a) as being obvious over Bagrodia et al. in view of Frank and Maxfield et al. (WO 93/04117) for the reasons on page 6.

Claims 1, 2, 3-6, and 9-11 have been rejected under 35 U.S.C. §103(a) as being obvious over Maxfield et al. in view of Frank for the reasons on pages 6-9.

Claim 7 has been rejected under 35 U.S.C. §103(a) as being obvious over Maxfield et al. and Frank in view of Oswold (US 4,136,103) for the reasons on pages 9-10.

Claims 17 and 18 have been rejected under 35 U.S.C. §103(a) as being obvious over Fujimoto et al. (JP 2000-322919) for the reasons on page 10.

Claim 19 has been rejected under 35 U.S.C. §103(a) as being obvious over Fujimoto et al. in view of Catlin (US 5,819,408) for the reasons on page 11.

These rejections are respectfully traversed and will be discussed together below.

The rejections should fall, because the cited prior art references, either alone or when combined, fail to teach, suggest or make obvious all of the limitations of amended claim 1 (which is the sole independent claim under examination), as required to support a *prima facie* case of obviousness.

The multi-step mixing in a single extrusion procedure.

The present invention

The present invention relates to a method of producing a polyamide nanocomposite from a partially crystalline polyamide and organically modified layered silicates. In this regard, claim 1, as amended, recites:

> A method of producing a polyamide nanocomposite from a partially crystalline polyamide and an organically modified layered silicate, said polyamide being processed as a first part and a second part in a single extrusion procedure in a double screw extruder having an intake,
> wherein the method comprises the following steps:

(a) dosing said first part of the polyamide as a granulate into the extruder intake and melting said first part of the polyamide in the extruder,
(b) dosing into and mixing the organically modified layered silicate with the melt of step (a), in a mixture ratio of 60 to 80 wt.% polyamide and 40 to 20 wt.% layered silicate,
(c) adding said second part of the polyamide to the mixture of step (c) in the double screw extruder via a side feeder or through dripping in the extruder to set the final concentration of the organically modified layered silicate at no greater than 10 % in the melt of the polyamide nanocomposite, and
(d) subjecting the resulting melt of the polyamide nanocomposite to filtration, wherein all of said steps (a)-(d) are carried out in the single extrusion procedure in said double screw extruder.

The present application further refers to the problem of inhomogeneous distribution of the layered silicate particles when being mixed with the polyamide (to a two compound system), resulting in a low surface quality (see page 6, line 33 to page 7, line 2, and page 13, lines 20- 35 of the published international application). As supported by the comparative example 1 (see page 10, line 16 to page 13, line 3) and the prior art cited by the examiner, the problem of such inhomogeneous distribution of such a two-component mixture for the nanocomposite production is well known in the art, and there are different proposals for solving this problem:

<u>Bagrodia et al. (WO 01/40369)</u>

The primary reference of Bagrodia et al. refers to a process for manufacturing a nanocomposite, and discusses the same problem as the present invention, namely a low dispersibility of layered clay material in a matrix polymer when producing nanocomposites (see page 10, lines 13 to 24 of Bagrodia et al.).

Bagrodia et al. discloses the two general concepts: (1) a two-component system, and (2) a three-component system.

First, at page 8, lines 8-10, Bagrodia et al. discloses the two-component system as introducing a composite material comprising at least one amorphous oligomeric resin having dispersed layered clay particles. However, no examples or other information such as detailed teachings are given for this system on how it is to be carried out. Applicants point out that this two-component system differs from the two-component system of the present invention in that:

a) the matrix here in Bagrodia et al. is amorphous, whereas in the claimed invention it is partially crystalline (see claim 1), and

b) the matrix here in Bagrodia et al. is an oligomer, whereas in the claimed invention it is claim 1 is a polymer (see claim 1).

Furthermore, Bagrodia et al. discloses this two-component system as an intermediate product, which is further

mixed with the matrix polymer to a three-component system. Thus, there is no teaching of this two-component system, which would be applicable to the claimed method of the instant application.

Second, Bagrodia et al. basically discloses a three-component system, wherein a "dispersion mediator" is introduced as a third component to a layered clay and a matrix polymer for solving the above-noted problem. It is to this three-component system that the complete disclosure in Bagrodia et al. (including the examples and claims) is directed.

In Bagrodia et al., the following three components are used: (a) a matrix polymer, (b) an amorphous oligomer, and (c) a layered clay material. These three components may be mixed either by mixing all three components at once in a one step process or in a two step process (see page 23, line 30 to page 24, line 5; and page 38, lines 6-18, page 44, lines 5-9). In the two step process, the first two components - the amorphous oligomer and the layered clay material - are mixed in a first step and then in a second step that melt is mixed with the third component, the matrix polymer (see page 23, line 30 to page 24, line 2, and page 38, lines 11 to 18). Thus, the layered clay material is not dispersed in the matrix polymer but in the amorphous oligomeric resin, which then serves as a mediator component when mixing with the matrix polymer. Accordingly, Bagrodia et al. teaches to use an additional, third component

(the amorphous oligomer) as a mediator for enhancing the degree of dispersion in the nanocomposite, whereas such is not called for in claim 1 of the instant application.

In sum, it is should be apparent that Bagrodia et al. considers the addition of a third component as a relevant solution for solving the above-noted problem, <u>while not recognizing the potential in the mixing step itself</u>.

Accordingly, in order to arrive at the claimed method, a skilled person, when starting with Bagrodia et al. as the closest prior art, has to find a teaching in the prior art disclosing or suggesting:

- To exclude the use of an amorphous oligomer from the production process - exactly to exclude that feature Bagrodia et al. consider to be the solution for solving the existing problems known in the art, and
- To raise the awareness that the mixing order itself is relevant for solving the problem,

<u>However, there is no such teaching in the cited references relied upon by the examiner</u>. For this reason, it is believed that the obviousness rejections should fall, because no combination of cited references would arrive at each and every element of independent claim 1.

Maxfield et al. (WO 93/04117)

The reference of Maxfield et al. does not remedy the above-noted problems associated with Bagordia et al.

Maxfield et al. refers to a process of forming a polymeric nanocomposite. Maxfield et al. is also confronted with the problem of low dispersibility of layered material in a polymer when producing nanocomposites. Maxfield et al. aims to uniformly disperse, e.g. layered silicates, in a polymer. See page 2, lines 19-21 of Maxfield et al. To solve this problem, Maxfield et al. discloses subjecting a melt mix of polymer and layered material to an additional shearing force, e.g. by transferring the mix into a separate mixer.

Accordingly, Maxfield et al. discloses a two step process comprising: (a) forming a flowable mixture of a melt-processable polymer and a swellable, polymer-compatible layered material, and (b) subjecting said mixture to a shear. The shearing action may be provided, e.g. by mechanical means, by thermal shock, by pressure alteration, or by ultrasonics (see page 29, lines 25-29). A detailed description is given for particular procedures on how best to apply the shear. However, Maxfield et al. explicitly discloses that the manner in which the flowable mixture is formed is not critical and conventional methods can be employed (see page 7, lines 9 to 11).

Thus, similar to Bagrodia et al., Maxfield et al. does not recognize the potential in the mixing procedure itself for achieving a higher dispersibility.

To summarize the teaching of these two cited documents, the prior art is well familiar with the negative effects of a low dispersibility of layered silicate in a polyamide when producing nanocomposites. In fact, both Bagrodia et al. and Maxfield et al. suggest solving that problem by different approaches: either to influence the degree of dispersion on a chemical level by adding an additional "mediator component" (Bagrodia et al.), or to apply additional shear forces onto the already existing mixture (Maxfield et al.). Both solutions are complicated and they put additional burden on the settings of the production process. Even more so, both documents do not consider or recognize that modifying the mixing process itself might bear a potential for achieving a higher degree of dispersibility. The teachings of Bagrodia et al. and Maxfield et al. stand in contrast to, and in no way suggest, the method of claim 1 of the instant application.

In contrast to Bagrodia et al. and Maxfield et al., the Applicants of the present application have recognized the potential of the mixing step itself for achieving a higher degree of homogeneous distribution of layered silicate particles in the polyamide of a polyamide nanocompound (see page 13, line 20 to

page 14, line 12). To this end, Applicants herein claim a production process with a two-component-multi-step mixing carried out in one single extrusion procedure. Indeed, by way of the instant application, the Applicants proves that the way of mixing two components is of high relevance for the degree of distribution of the layered clay particles in partially crystalline polyamide and for the quality of the resulting nanocomposite.

As presented in the description on page 14, lines 1-12, it was surprising that the surface quality may be improved by dosing the polyamide in distinct steps. For further support, see in particular, table 2, W4320 as an example according to the claimed method and W3082_V1 and W3082_V3 as comparative examples. The result achieved by the claimed method is unexpected, as the prior art has never even considered that mixing the components might even have an impact on the degree of dispersion and the surface quality of produced articles. To this end, it is believed that the claimed method achieves surprising and unexpected results over anything contemplated by the combination of Bagrodia et al. and Maxfield et al., either alone or when combined with themselves or any other cited reference.

Applicants respectfully point out that for an obvious selection of an order of mixing steps, these steps must be known. However, in contrast to the examiner's position, it is not a

selection of an order of known steps which is the issue here, but rather the provision of new steps for a mixing process. These new steps are provided in a new order. As these steps are not known in the relevant prior art, it cannot be obvious to select a certain order of steps which are not known per se.

Therefore, Applicants respectfully submit that the examiner's position that the selection of the order of mixing single components or parts thereof would be obvious for a skilled person is - in view of the problem to be solved and in view of the teaching of the cited prior art - simply wrong. As such, Applicants observe that the examiner cites case law which is not relevant to the present situation here. Applicants further get the impression that the examiner is not examining the subject matter of the claims. Applicants respectfully request the examiner to fully consider these arguments in the interest of expediting prosecution and to reduce the time and money spent associated with the prosecution of this case.

The Filtration Step

The present invention comprises, according to claim 1, a multi-step mixing process carried out in one single extrusion process. As a last step, a filtration step of the melt is carried out within the extrusion procedure. This filtration step even further enhances the degree of distribution of the layered silicates within the melt.

Bagrodia et al. teach the filtration of the organically modified layered clay as an isolation step after the modification. However, this step is not at all related to the melt for the nanocomposite but to a preparatory work. Therefore, the filtration step according to Bagrodia et al. is not relevant to the present invention as claimed.

Maxfield et al. teach a filtration step when preparing the layered material (organoclay). Thus, this filtration step is comparable to the filtration step of Bagrodia et al., being well known as an isolation step (page 38, line 35 to page 39, line 6). Therefore, the filtrations steps according to Bagrodia et al. and to Maxfield et al. are not relevant for the present invention as claimed.

Frank (US 5,217,762)

The examiner cites Frank when arguing against the inventiveness of the filtration step of the claims.

Frank discloses a method for the manufacturing of a sheet-like molded article from liquid crystalline polymers by a flat film extrusion die. Applicants point to the fact that a process with a liquid crystalline polymer may not be compared with a process with partially crystalline polymers (which are partially crystalline in their solid state). In particular, Frank discloses fully aromatic polyesters, as polymers. According to the method of Frank, the melt is subjected to a

"high temperature melt filtration" between 300°C and 400°C (column 5, lines 65 to 68) in order to eliminate flow irregularities that could lead to morphological defects and/or material infirmity in the produced molded sheets. Frank does not disclose the addition of layered silicates. Accordingly, in Frank, the filtration step is applied to a single-compound-melt of a completely different polymer. Therefore, Frank does not deal at all with the problem of the present invention, the low dispersibility of layered silicates in a partially crystalline, solid polyamide. Consequently, a skilled person cannot find a teaching that might help him solve the problem to arrive at the method of claim 1 of the present invention (or the problem of the other cited prior art documents), namely the low dispersion of layered silicates in the melt of a polyamide. Citing Frank as a relevant prior art document is therefore based on an *ex post facto* view, which is not allowable.

In sum, the cited prior art of Bagrodia et al. and Maxfield et al. disclose methods of producing nanocomposites. Further, both documents refer to the same problem as disclosed by the present invention, a low dispersibility of layered silicates in a polyamide when producing the nanocomposite thereof. However, both documents suggest a solution which renders the procedure complicated. Moreover, both documents do not consider or suggest a solution as provided by the present invention, namely the

provision of a multi-step mixing process which is carried out in one extrusion procedure and including a melt-filtration step.

Thus, it is to the references of Bagrodia et al., Maxfield et al. and Frank that the rejections stand or fall, because the examiner always cites these references in combination with other secondary references, as allegedly disclosing the core process of claim 1. In this regard, the examiner relies on the secondary references as disclosing the features of dependent claims 7 and 17-19. Further, the remaining secondary references do not remedy the above-noted deficiencies Bagrodia et al., Maxfield et al. and Frank, because they also do not disclose or suggest method of claim 1.

As to the obviousness rejections of claims 17-19 over Fujimoto et al. and Catlin, it should be noted that these claims depend, either directly or indirectly, on claim 1. Contrary to the examiner's position, these dependent claims require the recited features of claim 1, including the use of the resultant polyamide nanocomposite of claim 1 as a molding compound. Applicants have amended these claims to better reflect this. Yet, the examiner relied on Fujimoto et al. and Catlin solely for disclosing gas injection molding of thermoplastic resins into parts during injection molding. These references mention nothing with respect to the resultant polyamide nanocomposite of claim 1

as a molding compound. Nor do these references remedy the above-noted deficiencies in the other cited references.

For these reasons, it is believed that the claims, including the claims prior to this amendment, fulfill the requirements for novelty and non-obviousness. Nonetheless, for the sole purpose of improving clarity, Applicants have amended independent claim 1 in order to present more detailed single steps to be carried out. The respective sources of disclosure are given to the amended parts and refer to the published international application (WO 2004/022651 A2).

Thus, the above-noted obviousness rejections should fall, because the combined prior art references fail to disclose or suggest each and every element of independent claim 1, as required to support a *prima facie* case of obviousness. For these reasons, claim 1 and all claims dependent thereon are novel and patentable over the cited prior art references, either alone or when combined.

Therefore, the above-noted obviousness rejections are untenable and should be withdrawn. Withdrawal of the rejections is requested.

IV. Conclusion

Having addressed all the outstanding issues, the amendment is believed to be fully responsive to the Office Action. It is respectfully submitted that the claims are in

condition for allowance, and favorable action thereon is requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact the undersigned attorney at the telephone number below.

Respectfully submitted,

BROWDY AND NEIMARK, P.L.L.C.
Attorneys for Applicant(s)

By Jay Williams
Jay F. Williams
Registration No. 48,036

JFW:pp
Telephone No.: (202) 628-5197
Facsimile No.: (202) 737-3528
g:\bn\o\oxpa\stoppelmann2\pto\2009-10-20 amendment.doc